

**CALIFORNIA DIVISION OF MINES AND GEOLOGY**

**FAULT EVALUATION REPORT FER-152**

**Breckenridge Fault, Kern County**

by

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**July 26, 1983**

**INTRODUCTION**

The Breckenridge fault is identified as a northerly trending Quaternary fault by Jennings (1975; see Figure 1). This fault is being evaluated as part of a statewide program to identify and zone faults that are sufficiently active and well defined (see Hart, 1980).

**SUMMARY OF AVAILABLE INFORMATION**

The Breckenridge fault lies in the Breckenridge Mountain 15-minute quadrangle, in the southern part of the Sierra Nevada geomorphic province. To the south are the Tehachapi Mountains, a region where compressional stresses are dominant. To the east, the tectonic regime is one of extension. To the west, extension also appears dominant, although the driving tectonic forces do not appear to have caused nearly the magnitude of faulting as has occurred to the east. To the north lies the Sierra, a massive block of granitic terrain.

Dibblee and Chesterman (1953) described the Breckenridge fault as a northerly trending, vertical to steeply east-dipping, normal fault. They considered the fault to be a part of the Kern Canyon fault zone, which trends parallel to the Breckenridge fault (see Figure 2). The southern end of the Kern Canyon fault is located about a mile east of the northern end of the Breckenridge fault. The Kern Canyon fault has been described as a right-lateral fault by Moore and others (1983) and as a left-lateral fault by Alvarez (1962). While Moore and others indicate that the Kern Canyon fault locally has not been active during the last 3.5 million years, Alvarez reports "scarplets in alluvium" north of Isabella Reservoir, implying the fault might be active.

The Breckenridge fault is located about 5 miles north of the northeastern end of the northeasterly trending zone of fault rupture observed after the 1952 Kern County earthquake (Buwalda and St. Amand, 1955). Although the largest amount of displacement in 1952 occurred as reverse movement along the White Wolf fault, near the northeastern end of the rupture zone is discontinuous and the displacements were largely reported as left-lateral with vertical or extensional

components, or indeterminate (Buwalda and St. Amand, 1955). These faults trended northerly to northeasterly, closer to the trend of the Breckenridge fault.

The Breckenridge fault borders the western margin of the Walker Basin, a triangular-shaped alluviated valley. Dibblee and Chesterman (1953, p. 45-46) stated that the Breckenridge fault was not exposed, but that its existence "...is clearly indicated by the abrupt rise of the Breckenridge Mountain front along a remarkably straight base. Spurs of this steep mountain front are abruptly terminated along this line by triangular facets facing Walker Basin, and canyons between the spurs are narrow, V-shaped and steep, with small alluvial fans at their mouths." Dibblee and Chesterman inferred that more than 4000 feet of displacement has occurred along this fault, based on the difference in elevation of Breckenridge Mountain and the valley floor. They depict the alluvium of Walker Valley as faulted and stated the alluvium is "Recent" (Holocene). However, on page 43 of their paper, they describe the "Recent alluvium" under the heading of "Pleistocene Sediments" which raises a question about the age of the alluvium. They indicated that the thickness of this alluvium is unknown, "... but probably exceeds 300 feet, and may be as much as 1,000 feet" (Dibblee and Chesterman, 1953, p. 43). Their cross-section clearly shows the alluvium as faulted. Based on these inferred relationships, Dibblee and Chesterman (p.53) concluded that the Breckenridge fault was active during late Pleistocene time. They do not discuss the Holocene history of the Breckenridge fault.

Buwalda and St. Amand (1955) indicated that some (uncited) persons have thought the Breckenridge fault was a continuation of the White Wolf fault. Therefore, after the 1952 earthquake, they checked the Breckenridge fault to determine whether surface rupture had occurred. They reported finding "ruptures" near the southern end of the Breckenridge fault, as follows:

"In a borrow pit at 67 [Figure 2], on the west side of the highway 5/8 mile south of Rankin Ranch... several ruptures were found.... One about 125 feet long crossed the east edge of the quarry; the south part of it is on a rock-cut surface and the north part of an east-sloping grassy hillside. It is crooked and a quarter to half an inch wide. About 400 feet east of the highway there is a crack about 40 feet long on the top of the next little north-south ridge east of the quarry. It is about 1/4 inch wide and trends N. 5° E. There are a number of small north-south cracks hereabouts. All seemed to be tension cracks; there was no suggestion of vertical or horizontal offset.

"No ground ruptures attributable to the recent earthquake or scarplets in the alluvium produced by geologically late movements on the Breckenridge fault were found at the base of the Walker Basin scarp" (Buwalda and St. Amand, 1955, p. 53).

## INTERPRETATION OF AERIAL PHOTOGRAPHS

Black and white aerial photographs (Army Map Service, 1954; approximate scale 1:80,000) were stereoscopically examined using an Old Delft stereoscope. Stereo coverage of the fault was not available for the southern tip of Walker Basin, including the "ruptures" reported by Buwalda and St. Amand (1955; see above and Figure 2).

Along the western margin of Walker Basin, the Breckenridge fault appears on the aerial photographs as a slightly arcuate, but reasonably linear, valley-bounding hillfront. This hillfront is quite steep, and might possibly be considered, as indicated by Dibblee and Chesterman (1953; see above) to possess faceted spurs. However, this steep hillfront appears fairly dissected, and the "faceted spurs" are not well defined since they lack any truly planar surfaces. No scarps across any of the alluvial fans fronting the range were evident on these photos.

To the north of the valley, the western branch mapped by Dibblee and Chesterman (1953) is rather well expressed as a tonal lineament which locally coincides with topographic breaks or drainages. The poorly defined eastern branch is hardly expressed in the topography, at all.

## RESULTS OF FIELD RECONNAISSANCE

One-half day was spent in the field in an attempt to detect any evidence of recent displacement along the Breckenridge fault. No attempt was made to examine the "ruptures" reported by Buwalda and St. Amand, discussed above. This field reconnaissance included examination of the outlet stream at the southwestern end of the valley, examination of an adjacent roadcut in which a fault is poorly exposed, traversing three alluvial fans on foot, as well as making a rapid examination of the alluvial fans fronting the range (the latter was made by auto using the public road).

Near the outlet of Walker Basin, there is a roadcut in which weathered granitic material with some massive quartz outcrops is exposed. There is a suggestion that the dominant foliation dips rather steeply towards Walker Valley, but this may be more apparent than real because the roadcut trends approximately parallel to this foliation trend. One probable fault, striking N. 10° W., dipping 50° E., is exposed in this cut, juxtaposing similar granitic materials. This fault lacks any soft gouge, but the wavy surface exposed is suggestive of slickensides. If this fault is related to the Breckenridge fault, then the topography suggests that normal faulting has occurred. Based on this assumption, the orientation of the "slickensides" (plunging about 20° to the southeast) suggests that the displacement along the fault zone has been primarily right-lateral, with a slight normal component.

No fault scarps or similar features were observed on any of the three alluvial fans examined in reasonable detail. Neither were any scarps detected in any other alluvial deposits. The outlet of the valley lacks any evidence

that an active fault exists, especially an east-dipping, northerly trending, normal fault.

The Buwalda and St. Amand (1953) reference to possible fault rupture was not detected until after this field check was made. Therefore, these possible ruptures were not field checked.

#### SEISMICITY

Real and others (1978) do not show any concentration of epicenters along the Breckenridge fault. Indeed, according to Real and others, few epicenters are shown along the Breckenridge or the Kern Canyon fault, and those earthquakes that did occur in the vicinity of these two faults were all smaller than  $M = 5.0$ . However, Richter (1955, p. 179) indicates that two earthquakes larger than  $M = 5.0$  occurred near the south end of the Breckenridge fault during 1952. Allen (1983) determined that a series of small (generally less than  $M_L = 3$ ) earthquakes occurred in the vicinity of the Kern Canyon and Breckenridge faults between April 1 and September 30, 1982.

#### CONCLUSIONS

The Breckenridge fault has primarily been postulated based on geomorphic evidence. The existence of the closed, alluvial-filled Walker Basin appears to be rather compelling evidence for the existence of a fault. However, no faults have been directly observed in these sediments. The age of the sediments, as well as their thickness, have been inferred and not directly measured. The only report citing that a fault has been directly observed along this zone is this FER, and this fault is inferred to be a part of the Breckenridge fault zone.

Possible fault ruptures were reported immediately south of the Breckenridge fault in 1952. However, these same investigators (Buwalda and St. Amand, 1955) clearly indicated that they field checked the Breckenridge and found no evidence that movement had occurred along the Breckenridge fault in 1952. In addition, Buwalda and St. Amand (p. 53) indicated that they saw no scarps or similar features along the Breckenridge fault that would cause them to believe that the fault is recently active.

This investigation also failed to uncover any evidence that the Breckenridge fault has been active during latest Quaternary time, although field and photo observations were very limited. Therefore, the evidence is insufficient to demonstrate that the Breckenridge fault is sufficiently active (Holocene) to warrant zoning. Given the inability of any investigators to directly observe the main fault in outcrop and the lack of clearly defined geomorphic features (particularly small scarps) that would permit identification of recently active traces, it also appears that the fault is not sufficiently well-defined to warrant zoning.

As indicated above, "ruptures" were reported immediately south of the

mapped trace of the Breckenridge fault. Buwalda and St. Amand (1955) indicated that these ruptures consisted of extensional fractures. While these fractures could have resulted from fault movement, they are located almost 5 miles north of any other faults along which rupture occurred in 1952; thus, these "ruptures" may have resulted from downslope movement. However, lacking aerial photographs of the site of the reported ruptures and not having field checked the site, no conclusions are drawn as to whether or not these features warrant zoning.

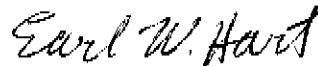
#### RECOMMENDATIONS

Based on the information summarized above, it appears that the Breckenridge fault should not be zoned at this time. Time and money permitting, additional aerial photographs of the southernmost part of the fault and of the reported 1952 ruptures should be acquired and interpreted. Ideally, the reported ruptures should be field checked in an effort to determine whether the movement resulted from faulting or landsliding, and to document the history of similar events in the same location.



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I have reviewed this FER and approve the recommendations. U.S. Department of Agriculture photos (1952, black and white, scale 1:20,000) were briefly reviewed, <sup>and they</sup> ~~but do not~~ suggest the existence of well-defined scarps in alluvium or other features that would suggest Holocene activity.



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March 27, 1984

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FER-152. Figure 1. Location of the Breckenridge fault  
(Jennings, 1975).

